Distributed Energy Resources Integration and Planning

Prepared by Josh Bode

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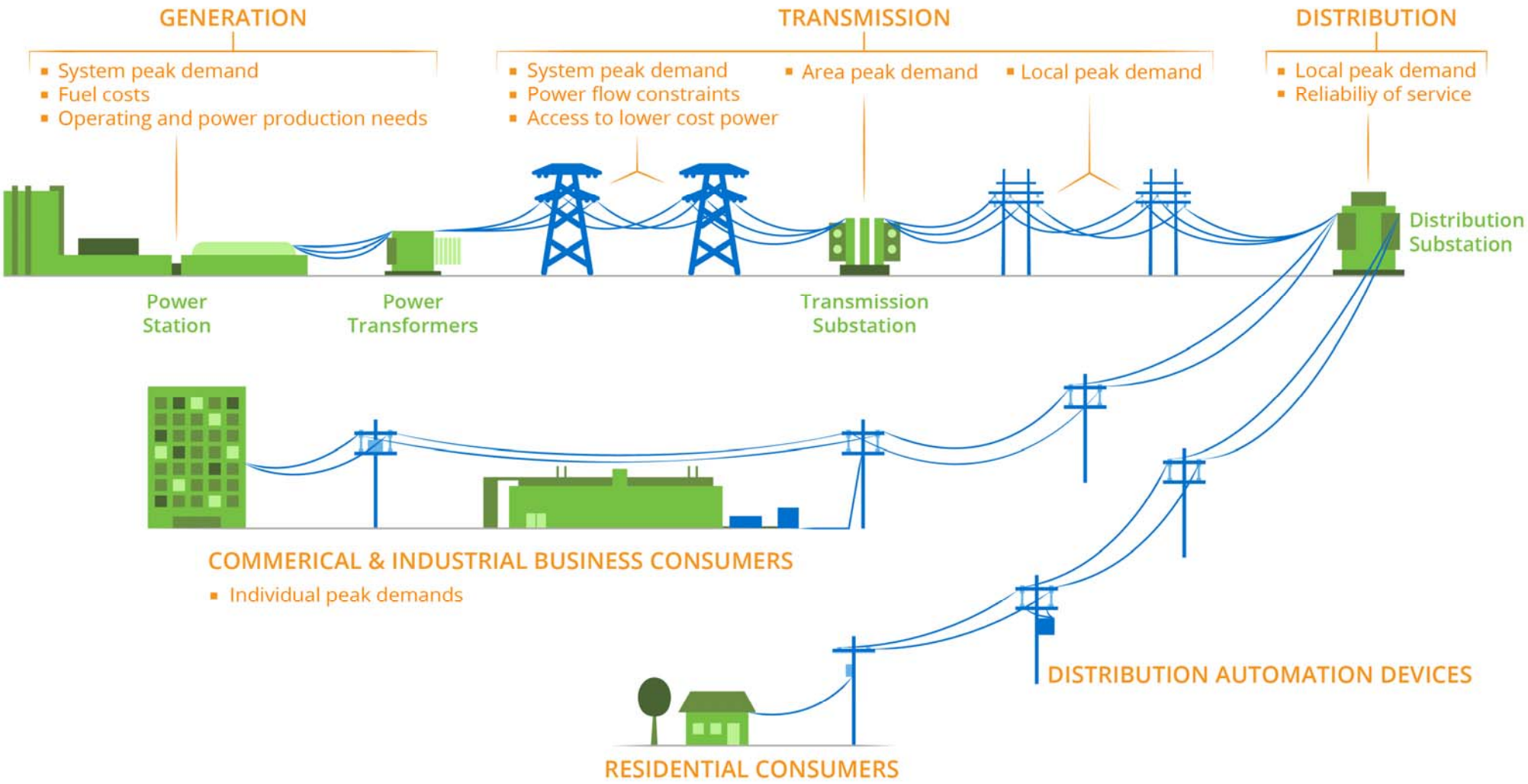
Nexant

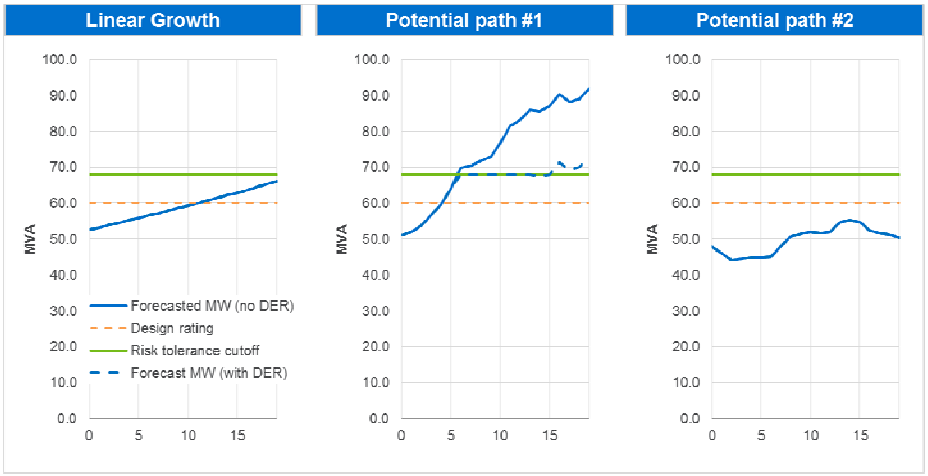
Reimagine tomorrow.

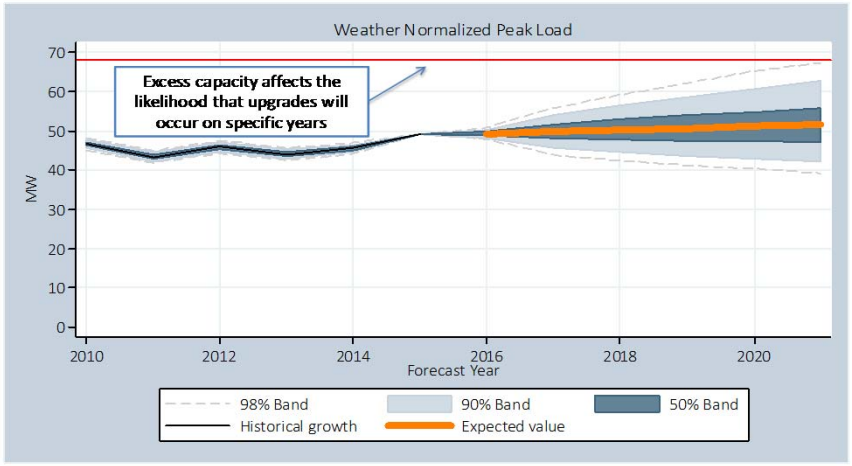
At the core is a debate about the value that DERs provide to the grid



- What is the locational (T&D deferral) value given the uncertainty in growth?
- How much value do specific DERs contribute given their characteristics?

Why use granular probabilistic planning methods?

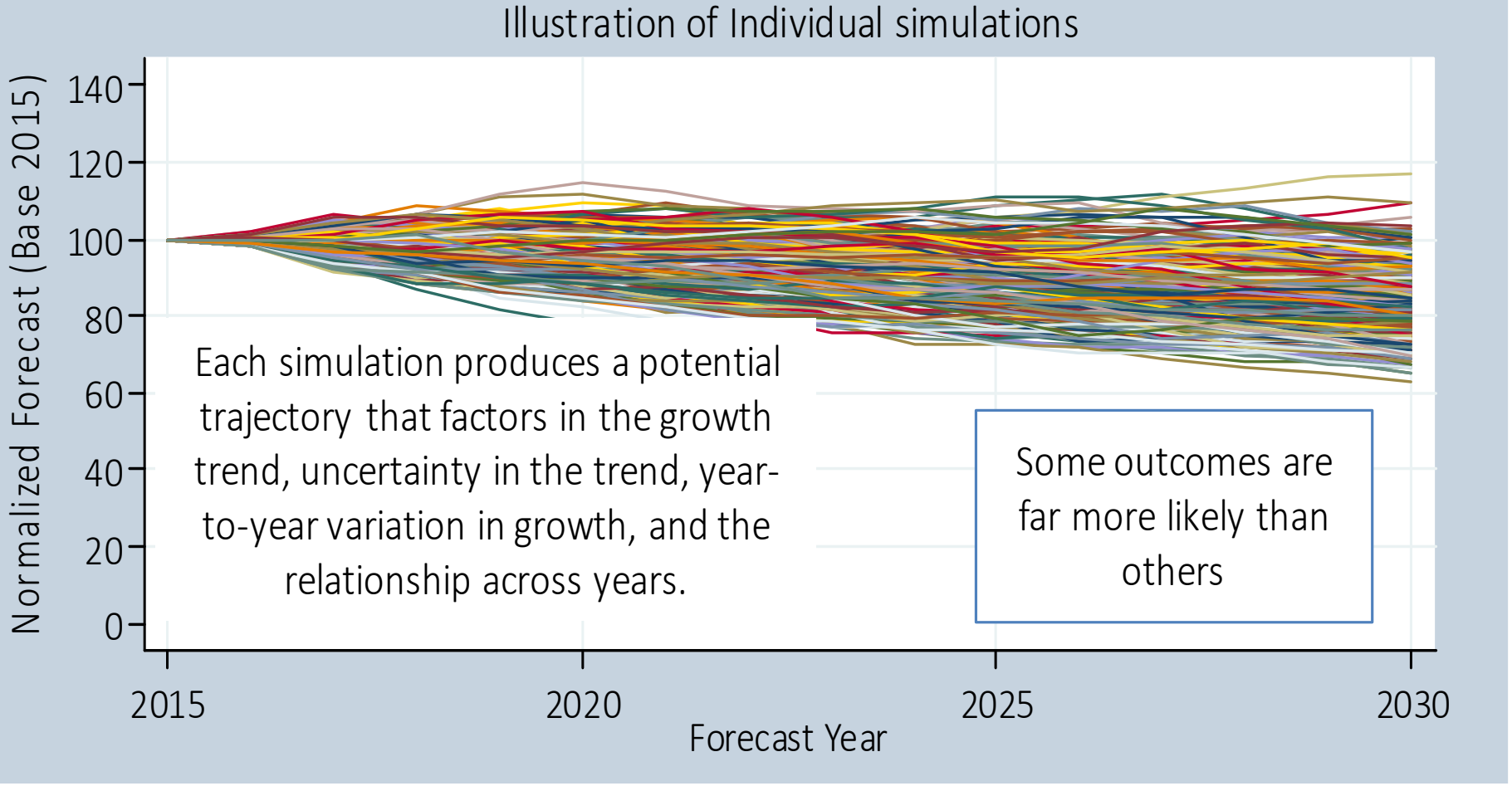




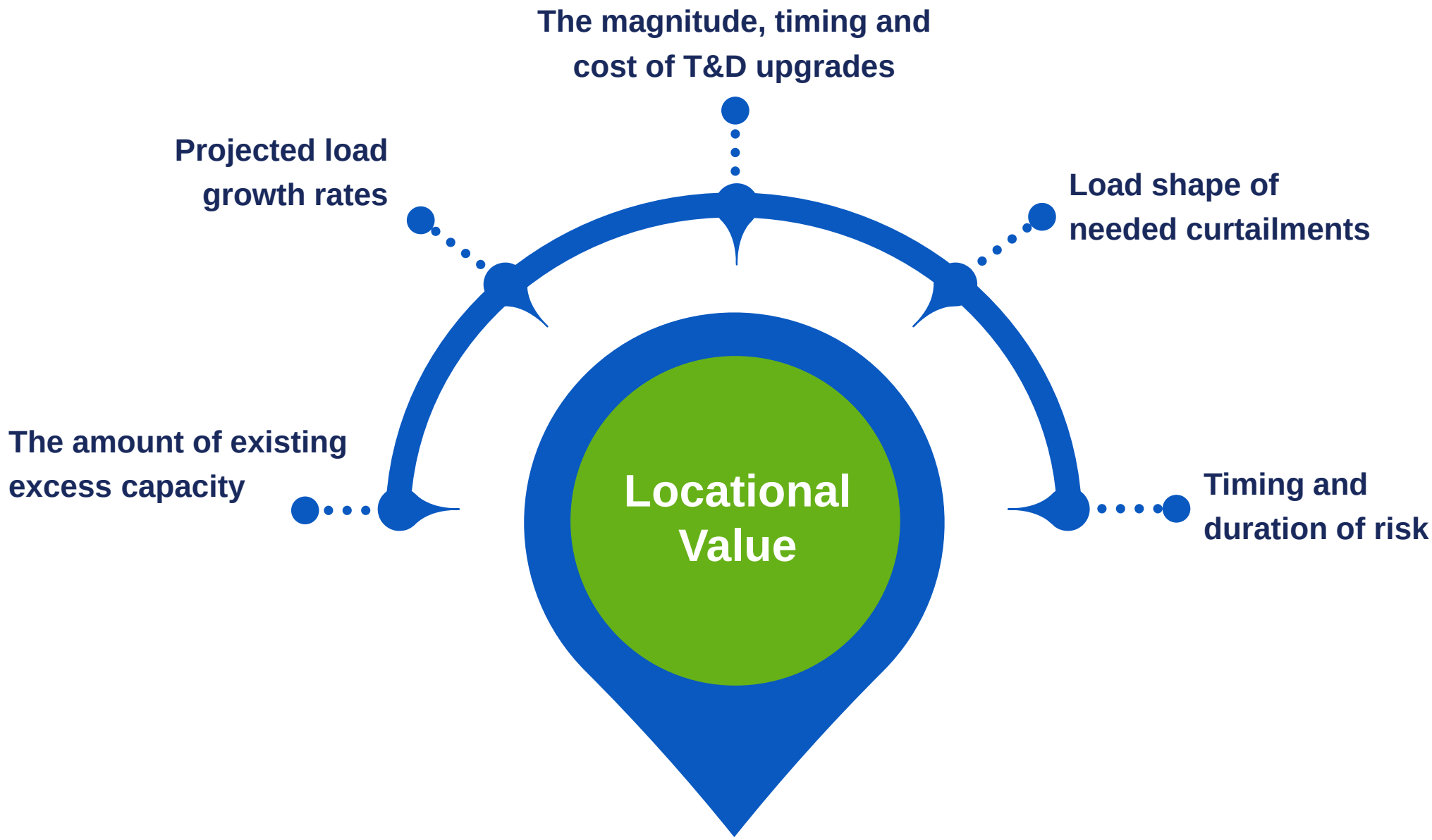
- No one knows precisely when loads will exceed ratings or by how much
- Linear forecasts assume precise knowledge. Actual growth trajectories are rarely linear.
- Because a linear forecast assumes exact knowledge, no value is assigned to the years an infrastructure upgrade is assumed to occur

- Forecasts inherently become more uncertain further into the future.
- Probabilistic methods, on the other hand, reflect the potential reality that infrastructure investment could be triggered earlier.
- They assign value to periods earlier than the linear forecast would dictate

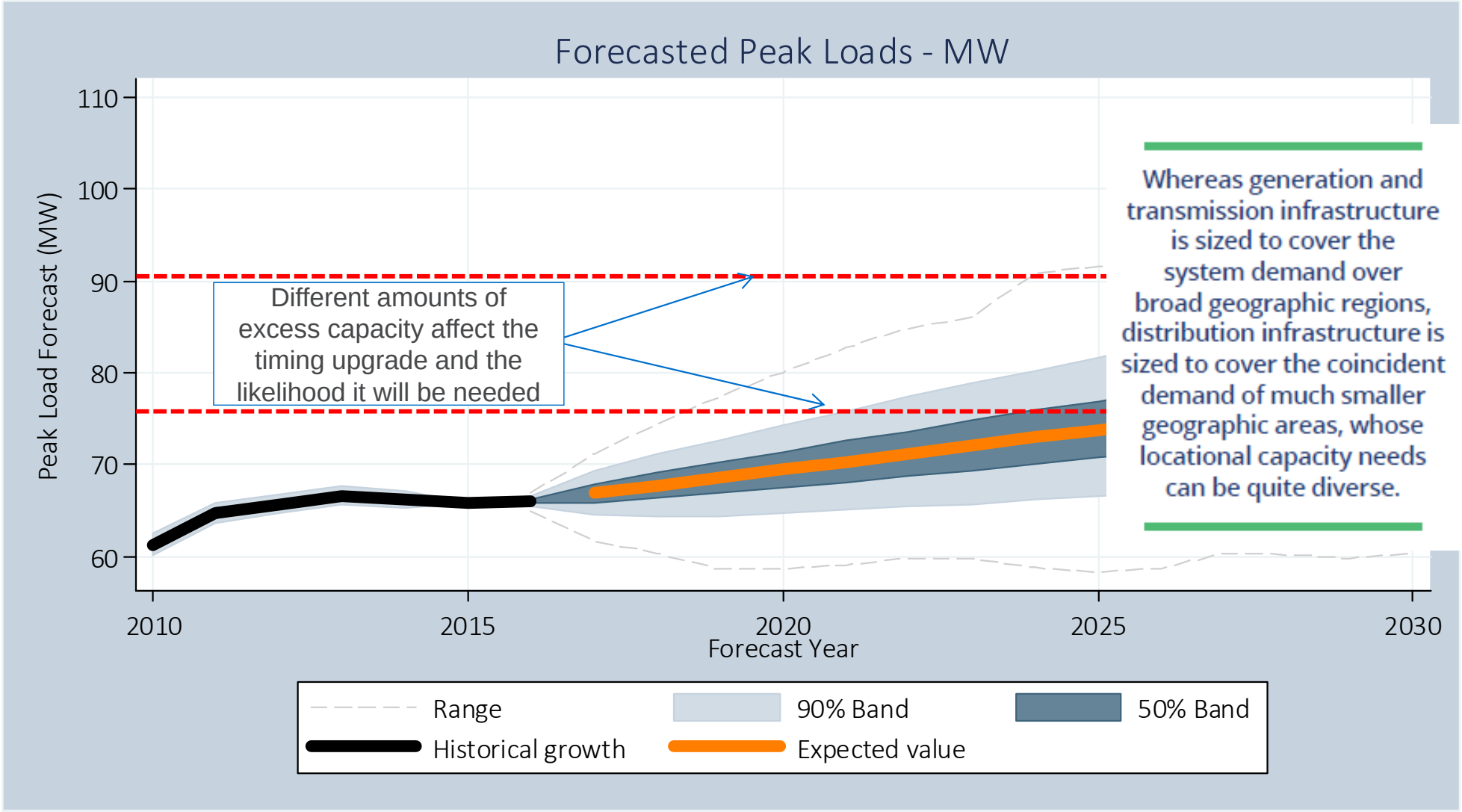
No one knows in advance precisely what path load growth will take



Several factors affect locational value of DERs



Concept #1: Excess capacity (or lack thereof) us a key driver of location value



Concept #2: Projected growth rates affect locational value

- If loads are declining, a wait and see approach may be advisable
- If loads are growing too fast, the amount of time a project may be deferred is minimal.

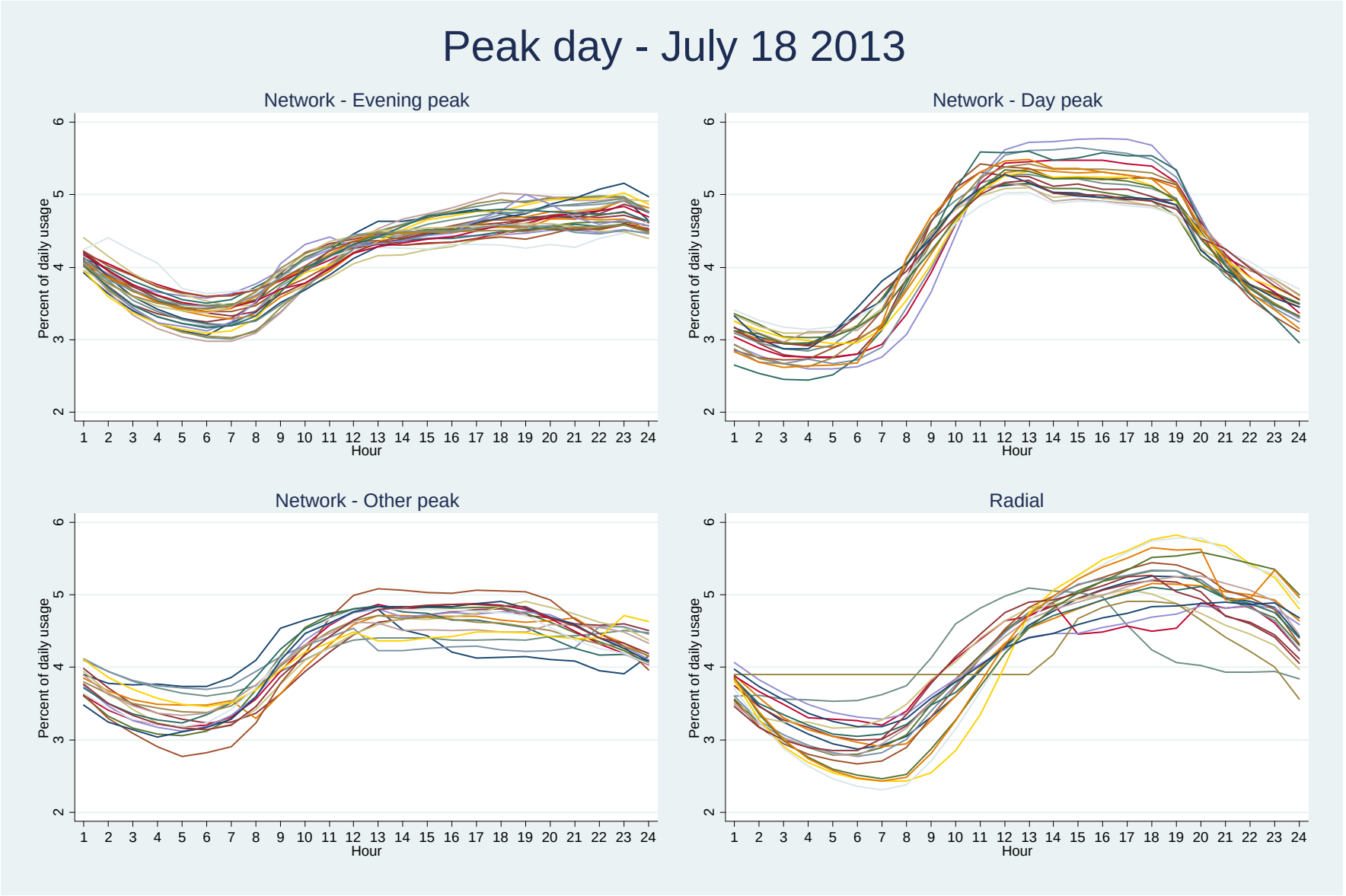
Concept #3: The magnitude, timing and cost of growth related T&D upgrades drive locational value

Calculations

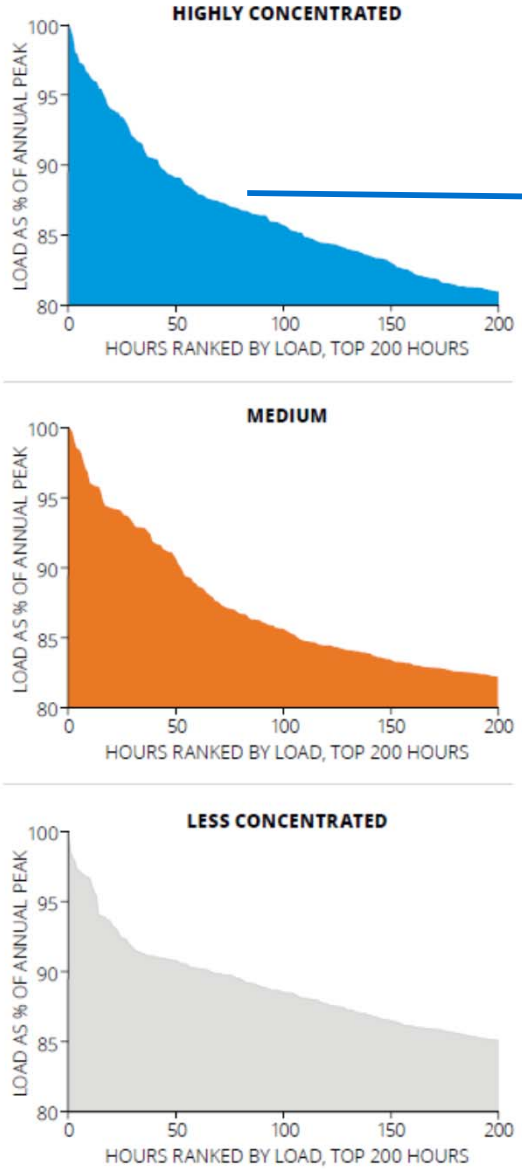
								Costs without DER		Costs with DER			
Forecast year	Annual growth	Cummulative growth multiplier	Forecasted MW (no DER)	Risk tolerance cutoff	MW over	DER resources needed	Forecast MW (with DER)	Annualized capital cost	O&M	Annualized Upgrade Cost (w DER)	O&M	**Avoided cost**	**$/kW**
0	5.3%	105.3%	54.8	65	0.0	0.0	54.8	$0	$0	$0	$0	**$0**	**$0.00**
1	4.8%	110.9%	57.6	65	0.0	0.0	57.6	$0	$0	$0	$0	**$0**	**$0.00**
2	4.5%	116.2%	60.4	65	0.0	0.0	60.4	$0	$0	$0	$0	**$0**	**$0.00**
3	1.2%	121.5%	63.2	65	0.0	0.0	63.2	$0	$0	$0	$0	**$0**	**$0.00**
4	1.9%	123.0%	64.0	65	0.0	0.0	64.0	$0	$0	$0	$0	**$0**	**$0.00**
5	1.6%	125.3%	65.2	65	0.2	0.2	65.0	$636,624	$176,584	$0	$0	**$813,208**	**$4,857.66**
6	-0.6%	127.4%	66.2	65	1.2	1.2	65.0	$636,624	$180,292	$0	$0	**$816,917**	**$664.08**
7	-2.0%	126.6%	65.8	65	0.8	1.2	64.6	$636,624	$184,079	$0	$0	**$820,703**	**$667.16**
8	-0.8%	124.1%	64.5	65	0.0	1.2	63.3	$636,624	$187,944	$0	$0	**$824,568**	**$670.30**
9	4.3%	123.0%	64.0	65	0.0	1.2	62.8	$636,624	$191,891	$0	$0	**$828,515**	**$673.51**
10	2.6%	128.4%	66.7	65	1.7	1.7	65.0	$636,624	$195,921	$0	$0	**$832,545**	**$477.71**
11	1.8%	131.7%	68.5	65	3.5	3.5	65.0	$636,624	$200,035	$0	$0	**$836,659**	**$241.26**
12	2.5%	134.0%	69.7	65	4.7	4.7	65.0	$636,624	$204,236	$0	$0	**$840,860**	**$178.85**
13	2.7%	137.4%	71.4	65	6.4	6.4	65.0	$636,624	$208,525	$0	$0	**$845,149**	**$131.31**
14	4.2%	141.1%	73.4	65	8.4	8.4	65.0	$636,624	$212,904	$0	$0	**$849,528**	**$101.41**
15	3.0%	147.0%	76.4	65	11.4	8.4	68.1	$636,624	$217,375	$783,683	$267,588	**-$197,272**	**-$23.55**
16	4.0%	151.4%	78.7	65	13.7	8.4	70.4	$636,624	$221,940	$783,683	$273,207	**-$198,327**	**-$23.67**
17	1.8%	157.4%	81.9	65	16.9	8.4	73.5	$636,624	$226,600	$783,683	$278,945	**-$199,403**	**-$23.80**
18	1.4%	160.2%	83.3	65	18.3	8.4	74.9	$636,624	$231,359	$783,683	$284,803	**-$200,503**	**-$23.93**
19	2.2%	162.4%	84.4	65	19.4	8.4	76.0	$636,624	$236,218	$783,683	$290,783	**-$201,625**	**-$24.07**

- Locational capacity value is driven by the deferral of traditional distribution investments
- The locational value will be greater were higher value investments can be deferred for longer
- The savings is the difference in the time value of money between investments with and without demand management

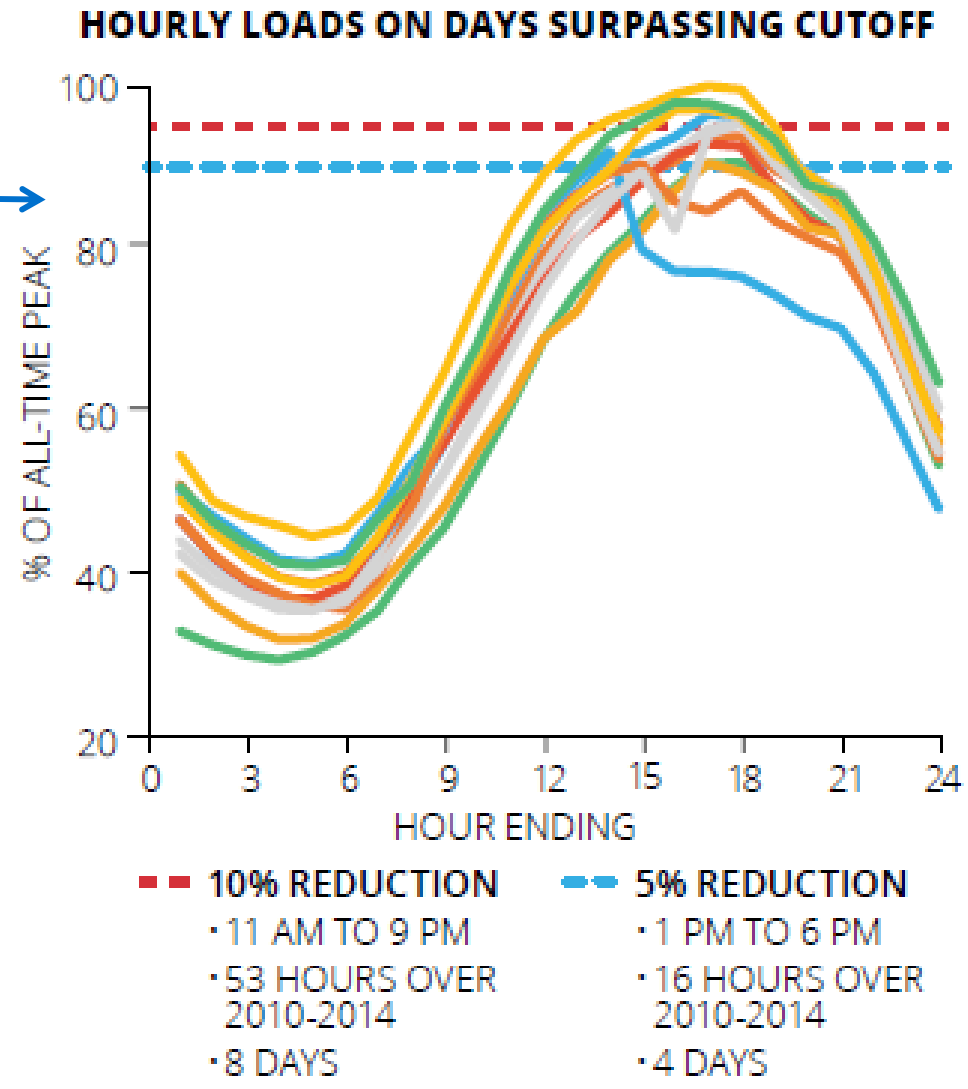
Concept #4: Load shapes matter and can vary substantially by location



Concept #5: Timing and duration of risk drive local capacity need



Source: Nexant



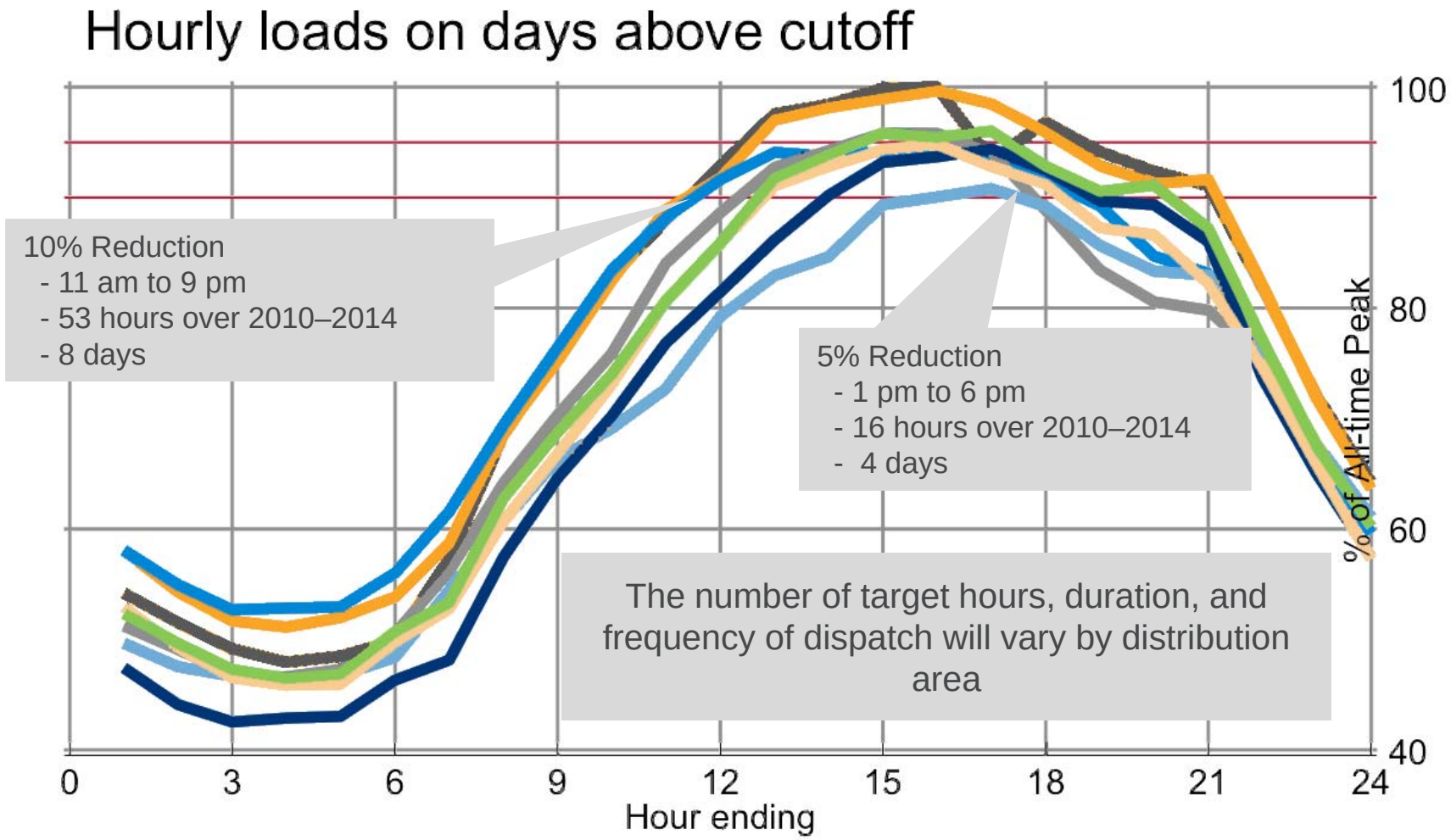
Source: Nexant

We must ask the right questions to understand DER value

1. **Is the DER tied to a specific load shape?**
   - How well does the resource shape align with local peaking risk?
   - Does it provide negative value for some hours (e.g., load shifting, snapback)
2. **Is the resource flexible?**
   - Can it be dispatched with different start and end hours?
   - Can the magnitude of output be controlled (ramping)?
   - How far ahead must it be scheduled?
3. **Are there specific operating constraints?**
   - When is it available?
   - For how long can the resource be sustained?
   - Are there limits on how often or when it can be dispatched?
   - What is the realization rate (e.g., percent of projected load relief that is actually delivered)?

The DER characteristics affect the value they provide at each location

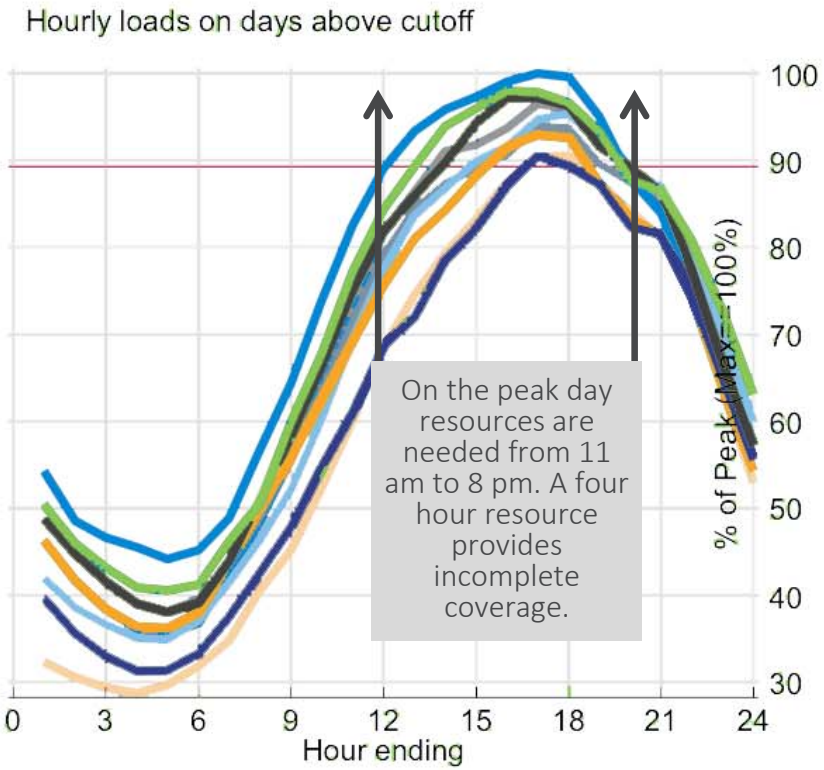
How many hours of relief are needed? When do they occur? For how long must production (or reductions) be sustained?

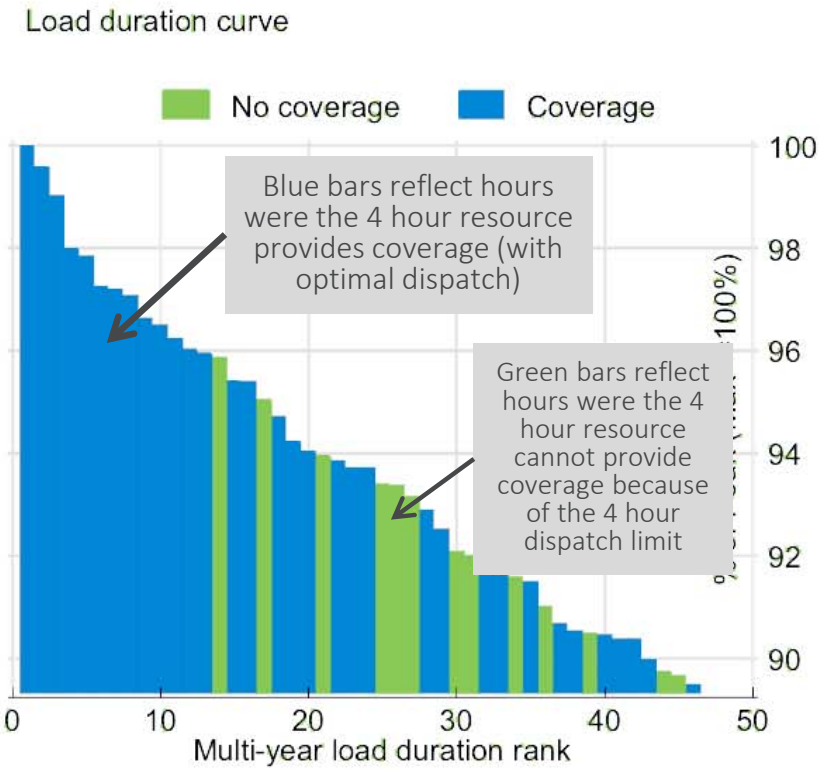


The historical load patterns can help assess if DER characteristics and constraints materially affect the ability to deliver resources when they are most needed

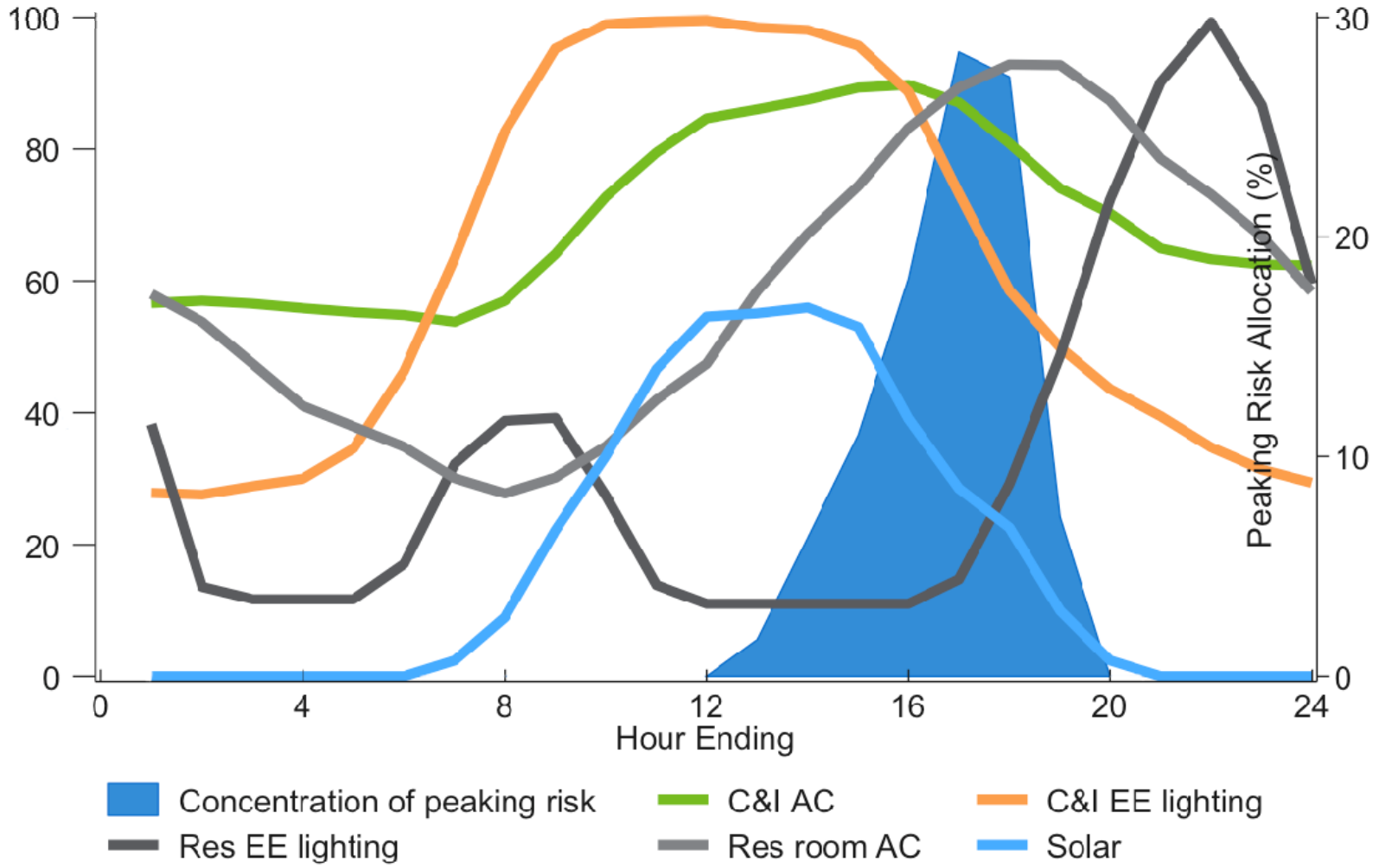
Resource characteristics impact the ability to shave loads

Impact of a four hour duration constraint





Value very much depends on how well characteristics of DERs align with local demand management needs

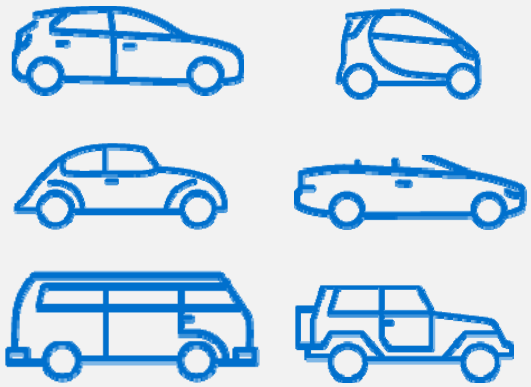


The whole is more important than the parts: maximizing DER value is a portfolio optimization problem, like building the optimal car

The optimal car…

- The “optimal” car is the one that provides the right balance of cost, reliability, speed, size, etc. for the available budget

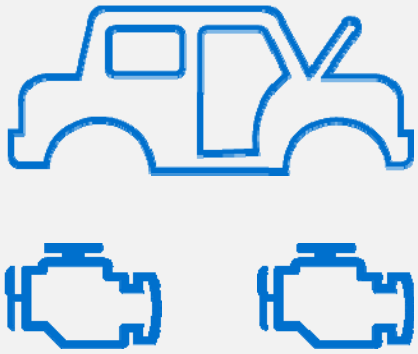
What kind of car is being built?



needs the right parts...

- A car without wheels is not useful for operation and it is superfluous to purchase two engines

Are there functional quantities of each part?



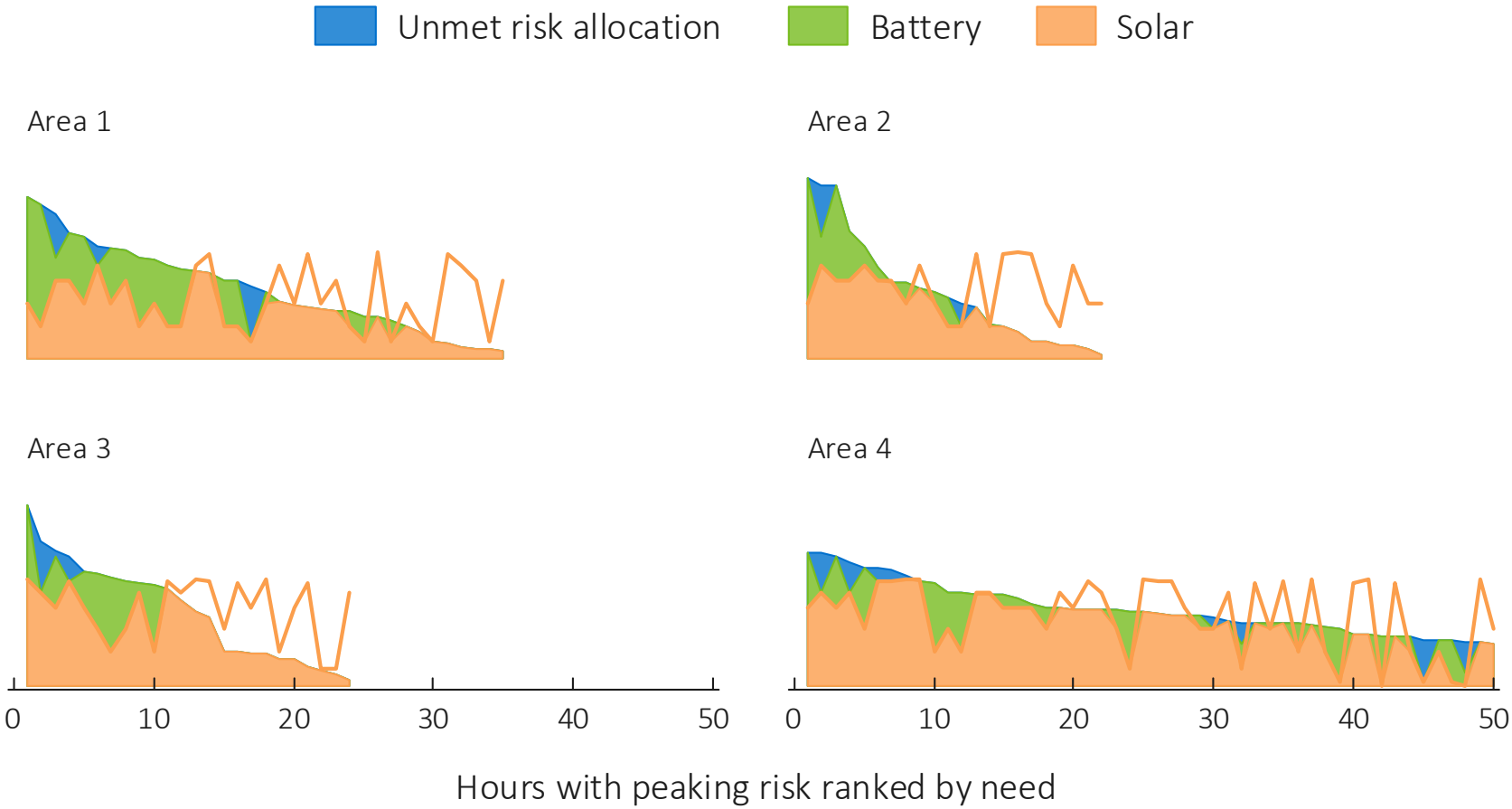
with the best value

- Purchasing only the cheapest parts or parts all from the same vendor may not provide the best value

What delivers the best value for the price?

Real world example: Solar + batteries

How well does solar cover the need?



For comments or questions, contact:

Nexant, Inc.
101 2nd Street, 10th Floor
San Francisco, CA 94105
415.369.1000

Josh Bode, M.P.P.
Vice President
415.369.1169 Office
415.786.0707 Mobile
jbode@nexant.com

Key steps in estimating location specific forecasting and T&D avoided costs

Planning methods are changing from deterministic to probabilistic and from top down to bottom up

- Clean the Data
- Estimate Historical Load Growth
- Simulate Load Growth Trajectories
- Estimate T&D Costs with and without DERs
- Time Differentiate Value